

What is claimed:

1. A method for removing a contaminant from the gas phase, comprising contacting an article comprising a fabric and at least one polyoxometalate, wherein the polyoxometalate is incorporated in the fabric to produce a polyoxometalate-modified fabric, with the gas phase containing the contaminant.
2. The method of Claim 1, wherein the polyoxometalate has the formula $[V_k Mo_m W_n Nb_o Ta_p M_q X_r O_s]^y [A]$, wherein M is at least one f-block element or d-block element having at least one d-electron, wherein M is not vanadium, molybdenum, tungsten, niobium, or tantalum; X is at least one p-, d-, or f-block element, wherein X is not oxygen; k is from 0 to 30; m is from 0 to 160; n is from 0 to 160; o is from 0 to 10; p is from 0 to 10; q is from 0 to 30; r is from 0 to 30; s is sufficiently large that y is greater than zero; and y is greater than zero, wherein the sum of k, m, n, o, and p is greater than or equal to four; and the sum of k, m, and q is greater than zero, and A is a counterion.
3. The method of Claim 2, wherein M comprises a d-block element having at least one d-electron.
4. The method of Claim 2, wherein M comprises titanium, chromium, manganese, cobalt, iron, nickel, copper, rhodium, silver, palladium, platinum, mercury, or ruthenium.
5. The method of Claim 2, wherein M comprises manganese.
6. The method of Claim 2, wherein M comprises cobalt.
7. The method of Claim 2, wherein M comprises ruthenium.
8. The method of Claim 2, wherein X comprises phosphorus, silicon, aluminum,

boron, cobalt, zinc, or iron.

9. The method of Claim 2, wherein A comprises a quaternary ammonium cation; proton; alkali metal cation; alkaline earth metal cation; ammonium cation; d- or f-block metal complex, or a combination thereof.
10. The method of Claim 2, wherein A is silver.
11. The method of Claim 2, wherein A is gold.
12. The method of Claim 2, wherein s is from 19 to 460.
13. The method of Claim 2, wherein the sum of k and q is greater than or equal to one, the sum of k, m, n, o, p, and q is 12, and s is 40.
14. The method of Claim 2, wherein k is not zero.
15. The method of Claim 2, wherein q is not zero.
16. The method of Claim 1, wherein the polyoxometalate has the formula $[X^{g+}V_bM^{h+}Z_{12-b-c}O_{40}]^u[A]$, wherein X is at least one p-, d-, or f-block element; g+ is the charge of X; M is at least one f-block element or d-block element having at least one d-electron, wherein M is not vanadium; h+ is the charge of M; Z is tungsten, molybdenum, niobium, or a combination thereof; b is from 0 to 6; c is from 0 to 6, wherein the sum of b and c is greater than or equal to one; u is greater than 3; and A is a counterion.
17. The method of Claim 16, wherein the polyoxometalate has the formula $[X^{g+}V_bZ_{12-b}O_{40}]^u[A]$, wherein X is at least one phosphorus, silicon, aluminum, boron, zinc, cobalt, or iron; b is from 1 to 6, and u is greater than 3.
18. The method of Claim 1, wherein the polyoxometalate has the structure

$[X^{s+}M^{h+}Z_{12-c}O_{40}]^u[A]$, wherein X^{s+} is at least one phosphorus, silicon, aluminum, boron, zinc, cobalt, or iron; c is from 1 to 6, and u is greater than or equal to 3.

19. The method of Claim 1, wherein the polyoxometalate has the formula $[X^{i+}_2V_uM^{j+}Z_{18-u-v}O_{62}]^w[A]$, wherein X is at least one p-, d-, or f-block element; i+ is the charge of X; M is at least one f-block element or d-block element having at least one d-electron, wherein M is not vanadium; j+ is the charge of M; Z is tungsten, molybdenum, niobium, or a combination thereof; u is from 0 to 9; v is from 0 to 9, wherein the sum of u and v is greater than or equal to one; w is greater than or equal to 4; and A is a counterion.
20. The method of Claim 19, wherein the polyoxometalate has the formula $[X^{i+}_2V_uZ_{18-u}O_{62}]^w[A]$, wherein X is at least one phosphorus, sulfur, silicon, aluminum, boron, zinc, cobalt, or iron; u is from 1 to 9; and w is greater than or equal to 4.
21. The method of Claim 19, wherein the polyoxometalate has the formula $[X^{i+}_2M^{j+}Z_{18-v}O_{62}]^w[A]$, wherein X is at least one phosphorus, sulfur, silicon, aluminum, boron, zinc, cobalt, or iron; v is from 1 to 9; and w is greater than or equal to 4.
22. The method of Claim 1, wherein the polyoxometalate has the formula $[YV_xZ_{12-x}O_{40}][A]$, wherein Y is phosphorus, silicon, or aluminum; Z is tungsten or molybdenum; x is from 1 to 6, and A is a counterion.
23. The method of Claim 1, wherein the polyoxometalate further comprises an organic group, an organosilyl group, an other p-block organometallic group, or a d-block organometallic group, wherein the organic group, the organosilyl group, the other p-block organometallic group, or the d-block organometallic group is bonded to the polyoxometalate.

24. The method of Claim 1, wherein the polyoxometalate comprises $H_5PV_2Mo_{10}O_{40}$.
25. The method of Claim 1, wherein the polyoxometalate comprises $K_8Co_2W_{11}O_{39}$.
26. The method of Claim 1, wherein the fabric is prepared from a fiber comprising polyamide, cotton, polyacrylic, polyacrylonitrile, polyester, polyvinylidene, polyolefin, polyurethane, polytetrafluoroethylene, or carbon cloth, or a combination thereof.
27. The method of Claim 1, wherein the fabric is prepared from a fiber comprising cotton, polyacrylic, or polyacrylonitrile.
28. The method of Claim 1, wherein the article comprises a garment, drapery, carpet, or upholstery.
29. The method of Claim 1, wherein the polyoxometalate is from 2.5 to 60 % by weight of the polyoxometalate-modified fabric.
30. The method of Claim 1, wherein the polyoxometalate is $H_5PV_2Mo_{10}O_{40}$ and the fabric is prepared from a polyacrylic fiber.
31. The method of Claim 1, wherein the polyoxometalate is $H_5PV_2Mo_{10}O_{40}$ and the fabric is prepared from cotton.
32. The method of Claim 1, wherein the contaminant comprises an aliphatic nitrogen compound, a sulfur containing compound, an aliphatic oxygenated compound, a halogenated compound, or a combination thereof.
33. The method of Claim 1, wherein the contaminant comprises acetaldehyde, methyl mercaptan, ammonia, hydrogen sulfide, methyl sulfide, dimethyl sulfide, dimethyl disulfide, trimethylamine, styrene, propionic acid, n-butyric acid, n-valeric acid, iso-valeric acid, or a combination thereof.

34. The method of Claim 1, wherein the contaminant is removed from the gas phase at from -50 °C to 105 °C and at a pressure of from 0.1 to 30 atm.
35. The method of Claim 1, wherein the contaminant is removed from the gas phase at from 25 °C to 105 °C and at 1 atm.
36. The method of Claim 1, wherein the contaminant is removed from the gas phase at 25 °C and at 1 atm.
37. A method for removing a contaminant from the liquid phase, comprising contacting an article comprising a fabric and at least one polyoxometalate, wherein the polyoxometalate is incorporated in the fabric to produce a polyoxometalate-modified fabric, with the liquid phase containing the contaminant, with the proviso that when the fabric is carbon cloth, then the polyoxometalate is not $\text{H}_5\text{PV}_2\text{Mo}_{10}\text{O}_{40}$.
38. A method for removing a contaminant from the gas phase or liquid phase, comprising contacting an article comprising a cellulosic fiber and at least one polyoxometalate, wherein the polyoxometalate is incorporated in the cellulosic fiber to produce a polyoxometalate-modified cellulosic fiber, with the gas phase or liquid phase containing the contaminant.
39. The method of Claim 38, wherein the contaminant is in the gas phase.
40. The method of Claim 38, wherein the cellulosic fiber comprises wood or paper.
41. The method of Claim 38, wherein the cellulosic fiber comprises paper.
42. A polyoxometalate-modified fabric, comprising a fabric and at least one polyoxometalate, wherein the polyoxometalate has the formula $[\text{V}_x\text{Mo}_m\text{W}_n\text{Nb}_o\text{Ta}_p\text{M}_q\text{X}_r\text{O}_s]^{y-}[\text{A}]$, wherein M is at least one f-block element or d-block element having at least one d-electron, wherein M is not vanadium,

molybdenum, tungsten, niobium, or tantalum; X is at least one p-, d-, or f-block element, wherein X is not oxygen; k is from 0 to 30; m is from 0 to 160; n is from 0 to 160; o is from 0 to 10; p is from 0 to 10; q is from 0 to 30; r is from 0 to 30; s is sufficiently large that y is greater than zero; and y is greater than zero, wherein the sum of k, m, n, o, and p is greater than or equal to four; and the sum of k, m, and q is greater than zero, and A is a counterion, wherein the polyoxometalate is incorporated in the fabric,

with the proviso that when A is a proton, the polyoxometalate is not the reaction product between $[V_k Mo_m W_n Nb_o Ta_p M_q X_r O_s]^y [A]$ and a pararosaniline compound,

with the further proviso that the polyoxometalate is not silicomolybdenic acid or its sodium salt, phosphomolybdenic acid, ammonium chromododecanemolybdenate, ammonium salt of hydrogen hexamolybdocobaltic acid, para-tungstic acid or its ammonium salt or sodium salt, meta-tungstic acid or its ammonium salt or sodium salt, phosphotungstic acid or its salt, silicotungstic acid or its salt, dodecane tungstodicobaltic acid or its salt, phosphotungstomolybdenic acid or its salt, or phosphovanadomolybdenic acid or its salt,

with the further proviso that when the fabric is carbon cloth, the polyoxometalate is not $H_5PV_2Mo_{10}O_{40}$.

43. The fabric of Claim 42, wherein k is greater than or equal to one.
44. The fabric of Claim 42, wherein the polyoxometalate further comprises an organic group, an organosilyl group, an other p-block organometallic group, or a d-block organometallic group, wherein the organic group, the organosilyl group, the other p-block organometallic group, or the d-block organometallic group is bonded to the polyoxometalate.

45. An article comprising the polyoxometalate-modified fabric of Claim 42.
46. An article comprising the polyoxometalate-modified fabric of Claim 44.
47. The article of Claim 45, wherein the article is garment, drapery, carpet, or upholstery.
48. The article of Claim 46, wherein the article is garment, drapery, carpet, or upholstery.
49. A method for making the polyoxometalate-modified fabric of Claim 42, comprising contacting the fabric with a polyoxometalate to produce the polyoxometalate-modified fabric.
50. The method of Claim 49, wherein the fabric is contacted with a mixture comprising the polyoxometalate and a solvent.
51. The method of Claim 49, wherein the contacting step is conducted at from 0 to 100 °C.
52. The method of Claim 50, wherein the solvent comprises water, acetone, toluene, or carbon dioxide.
53. The method of Claim 50, wherein the solvent can be used in supercritical drying technology.
54. The method of Claim 49, further comprising drying the polyoxometalate-modified fabric after the contacting step.
55. The method of Claim 54, wherein the drying step is from 0 to 220 °C at or below atmospheric pressure.

56. The method of Claim 54, wherein the drying step is conducted under supercritical conditions.